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CURTIS ELECTROMUSIC SPECIALTIES

CEM 3391

µP Controllable Dynamic Signal Processor

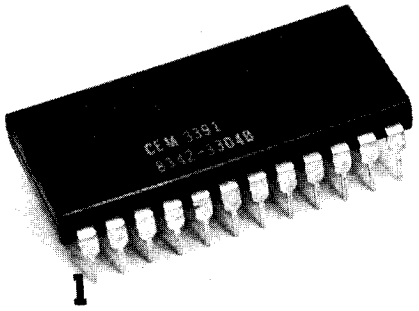
The CEM 3391 is a complete system for the dynamic signal processing of audio tone sources. Included on-chip are a dedicated four-pole low-pass voltage controlled filter with voltage controllable resonance, a quality final voltage controlled amplifier, two additional output VCAs for dynamic or pan control of the final signal into two separate outputs, and a complete ADSR envelope generator which controls the gain of the final VCA and, through a control VCA, can sweep the filter frequency in variable amounts. All nine control inputs are high impedance, low bias current inputs which range from 0 to +4.5V, a feature which eliminates the usual Sample & Hold buffers in a multiplexed DAC system.

A unique feature of the low noise, low feedthrough filter keeps the passband gain constant as resonance is varied, producing a rich and full resonance sound. Special care has been taken in the design of the final and two output VCAs as well as the filter to ensure low intermodulation distortion, for the clean processing of even polyphonic signals. The VCA design at the same time offers low accumlative noise and very low control feedthrough without trimming for "click" free performance.

The fully contained ADSR allows over 10,000:1 exponential control of the attack, decay, and release time constants, and control of the sustain level from 0 to 100% of the peak. Through selection of external components, the envelope may be direct coupled or AC coupled into the envelope amount VCA. The gate input is a dual function tri-level control: 0 to +5V gates the envelope on while +5V to +8.5V directly controls the gain of the final VCA, allowing the final VCA to be separately controlled with a simple organ AR type envelope.

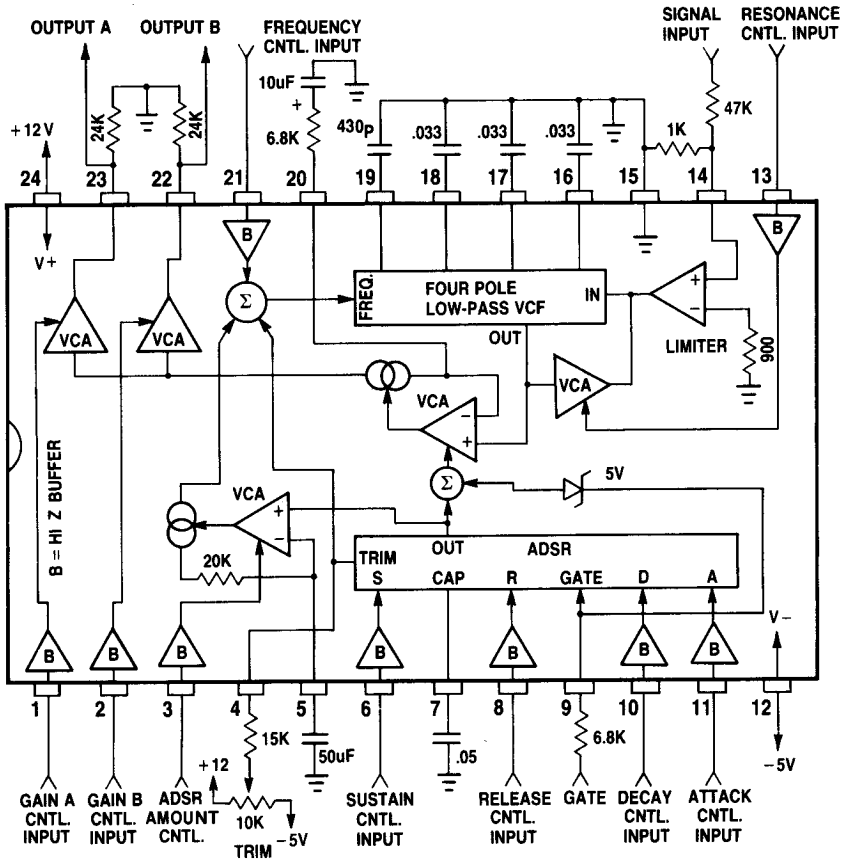
Features:

- Complete System On-a-Chip: a 4-pole VCF, Five VCAs, and Wide Range ADSR.
- Few External Components
- 0 to +4.5V, High Z Control Inputs for Direct Interface to CMOS Multiplexer from DAC.
- Constant Volume v.s. Resonance VCF Characteristic.
- Open Loop VCF Design for Rich Sound
- Temperature Compensated VCF Transconductors
- Low Noise, Low IM Distortion VCA
- Low VCA Feedthrough Without Trimming



- Variable ADSR amount into VCF with Either D.C. or A.C. Coupling.
- True RC (Exponential) ADSR Shape
- Separate Envelopes for VCA and VCF Possible

Block and Connection Diagram



CEM 3391

Electrical Characteristics

V_{CC} = +12V V_{EE} = −5V TA = 20°C				
Parameter	Minimum	Typical	Maximum	Units
FOUR POLE VCF				
Frequency Sweep Range	12	14	—	octaves
Frequency Control Input Range	−2.6	—	+4.5	V
Frequency Control Scale, Midrange	−0.47	−0.50	−0.53	V/octave
Frequency Scale Error[1]	—	0.3	1.0	%
Temperature Coefficient of Scale	+3000	+3300	+3600	ppm
Frequency at V_{FREQ} = 0V ($C_A = C_B = C_C = .033\mu F; C_D = 430pF$)	500	700	980	HZ
Tempco of Frequency at V_{FREQ} = 0V	—	±500	—	ppm
Resonance Control Range	0dB	—	oscillation	
Control Input for No Resonance	+0.1	—	+0.4	V
Control Input for Oscillation	+2.3	+2.8	+3.3	V
Input Signal Level for 1% THD	—	85	—	mV.P.P.
Frequency Control Feedthrough Referred to Input[2]	—	2.0	4.0	mV.P.P.
Resonance Control Feedthrough Referred to Input	—	4	15	mV.P.P.
Total System Noise Referred to Input	—	1.0	2.0	μV.R.M.S.
Passband System Gain, No Resonance[3]	7.0	8.7	10.5	xR_O/R_G
Passband Gain Change from 0 to Maximum Resonance	−4	−2	0	dB
Signal Input Bias Current	−0.1	−0.3	−1.0	μA
Frequency Control Input Bias Current	—	−0.5	−3	nA
Resonance Control Input Bias Current	—	−0.07	−0.4	nA/V
FINAL VCA & TWO OUTPUT VCAs				
Channel Gain Control Input For 80 dB Attenuation[4]	+0.03	—	+0.2	V
For Maximum Gain	+4.5	+4.8	+5.1	V
Maximum Output, Each Channel[5]	—	—	±500	μA
Current Gain, Pin 20 to Each Channel Output[6]	0.32	0.40	0.50	
Pin 20 DC Voltage	−1.0	0	+1.0	V
Output Voltage Compliance	V_{EE}+1.6	—	V_{CC}−1.0	V
ADSR Feedthrough Without Trim	—	0.5	5	μA
Gain Control Input Bias Current	—	−0.07	−0.4	nA/V
ADSR AMOUNT VCA				
Sweep Range of VCF	7.5	8.0	8.5	octaves
Sweep Leakage at V_{MOD} = 0	—	—	15	cents
Control Input for Maximum Sweep	+4.0	+4.3	+4.6	V
Amount Control Input Bias Current	—	−0.07	−0.4	nA/V
ADSR GENERATOR				
Attack Time Range[7]	10,000:1	—	—	
Decay/Release Time Range[8]	10,000:1	—	—	
Attack Time at V_{ATK} = 0	8.7	12	16.5	mS/μF(C_T)
Decay/Release Time Constant at $V_{D,R}$ = 0	2.9	4.0	5.5	mS/μF(C_T)
Time Control Voltage Range[9]	−1.0	—	+6.0	V
Time Control Scale Factor, Midrange	+1.06	+1.13	+1.21	V/decade
Time Control Input Bias Current	—	−0.5	−3	nA
Sustain Level Range	0	—	100	% of Peak
Sustain Level at V_{SUS} = 0	—	1	2	% of Peak
Sustain Control Voltage for 100% Peak	+4.2	+4.5	+4.8	V
Sustain Control Input Bias Current	—	−0.05	−0.3	nA/V
Change of Sustain Level with Time Control Voltages	—	1	3	mV
Change of Final Release Level with Time Control Voltages		NONE		
Voltage at Gate (pin 9)	+2.7	+2.9	+3.1	V
Gate Low (Off) Input Current[10]	+200	+270	+330	μA
Gate High (On) Input Current[11]	+65	+90	+110	μA
Threshold for Control of Final VCA by Gate	+5.0	+5.5	+6.0	V
Gate Voltage for Maximum Final VCA Gain	+8.0	+8.5	+9.1	V
SUPPLIES				
Positive Supply Range[12]	+11	—	+16	V
Negative Supply Range[12]	−4.5	—	−12.5	V
Supply Current	11.8	14.7	18.5	mA
Voltage at Trim (Pin 4 Open)	−1.2	−1.4	−1.6	V
Trim Input Resistance	−2.5	3.2	4.0	kohm

Notes

Note 1. For frequency control voltages between −1.5V and +2.5V. For voltages outside this range, maximum error increases to 10%.

Note 2. Frequency control voltage changes between −1.5V and +3.5V.

Note 3. As measured at channel A or B output. Final VCA and 2 channel VCAs at maximum gain. R_O = is output resistor, R_G = A.C. resistance from pin 20 to ground.

Note 4. Referred to maximum gain.

Note 5. Before VCAs generate severe distortion. Maximum recommended output is ±200μA.

Note 6. All VCAs are at maximum gain.

Note 7. Attack rise contour from 0 to peak is linear.

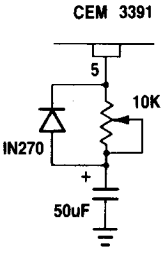
Note 8. Decay/Release fall contour from peak to sustain or sustain to 0 is RC (exponential).

Note 9. Nominal range for 3,000:1 time range is 0 to +4.5V.

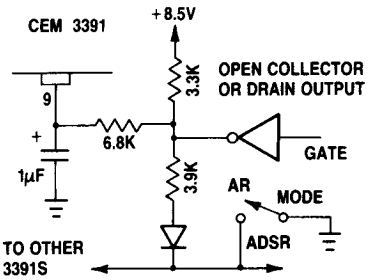
Note 10. Varies proportionally with supply.

Note 11. For attack control voltage = +4.5V. Values are somewhat higher for faster attack times.

Note 12. Maximum supply across chip is 26V.



ADSR AMOUNT TRIM, AC COUPLING



SELECTABLE AR OR ADSR ENVELOPES FOR FINAL VCA

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